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Magnetic Reorientation and Oxygen
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Introduction: The total free energy of a ferromagnet depends from the orientation of the magnetization with respect to the crystallographic axis, thus originating a magnetic anisotropy. Magnetic anisotropies are of great technological importance: they define easy and hard axis for the magnetization of materials. The prospect of effectively manipulating magnetic anisotropies is a major drive in the research on magnetic films. Additionally magnetic anisotropies are of considerable theoretical interest. Their energies are very small (typically ~1 μeV/atom) and only recently first principle calculations are approaching the level of accuracy required to treat them correctly. It seems therefore appropriate to provide experimental data for comparison with theory.[1]

Methods and Materials: By spin- and angle-resolved photoemission we have studied the effect of oxygen adsorption on the magnetic reorientation of Fe(110) ultra-thin films epitaxially grown on W(110).

Results: Oxygen has two opposite effect on this reorientation. For very low coverages ($\theta \leq 0.25$ ML) the critical reorientation thickness (t_R) increases with respect to the bare Fe films. At higher coverages, t_R gradually decreases to its clean surface value ($\theta = 0.33$ ML) and even further (see Fig.1). The initial increase of the surface anisotropy followed by its reduction is correlated with the presence of two distinct dispositions of the adsorbed oxygen atoms on the surface. At low coverages oxygen forms a c(2x2) on Fe(110) followed by a c(3x1) at higher coverages. (see Fig.)

Conclusions: In Fe(110) ultra-thin films, t_R can be considerably shifted to lower or higher values by regulating the oxygen adsorption on its surface.

References: [1] K. De'Bell et al., Rev. Mod. Phys. 72, 225 (2000)

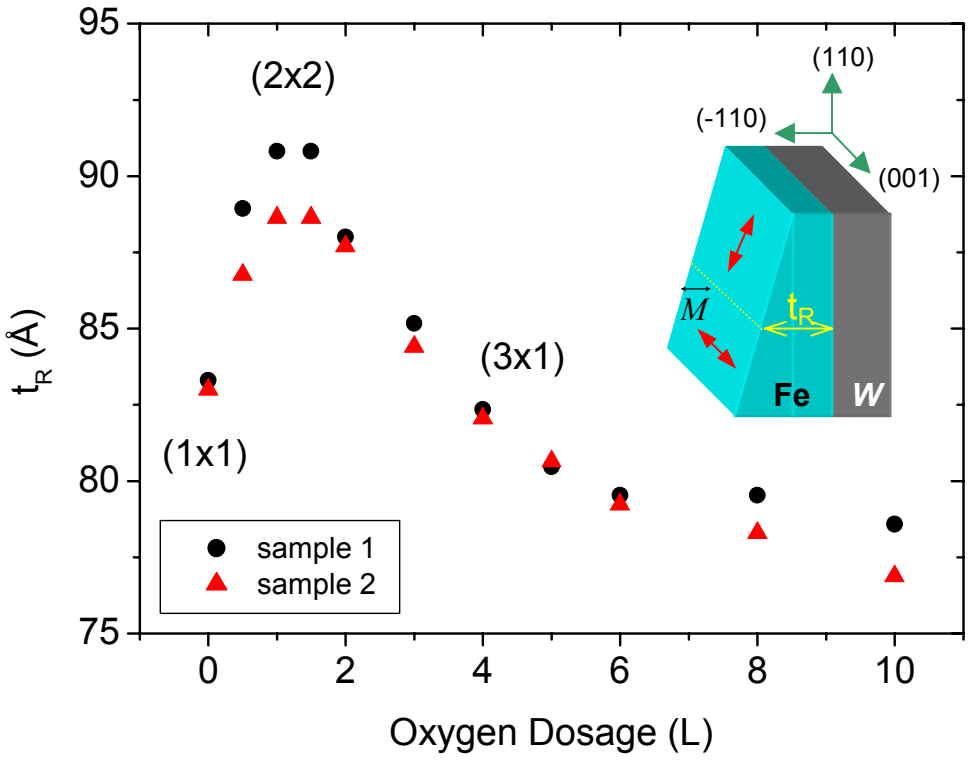

Figure 1: The critical reorientation thickness (t_R) changes as a function of oxygen dosage.